# 1.5 COLLABORATIONS BETWEEN METEOROLOGISTS AND EMERGENCY MANAGERS: THE OKLAHOMA TORNADO OF 3 MAY 1999 PART 2: RURAL APPLICATIONS OF MODERN WEATHER INFORMATION DURING A DISASTER

Dale A. Morris*
Oklahoma Climatological Survey,
The University of Oklahoma
Norman, OK 73019

John Lewis
Guthrie/Logan County Emergency Management
Guthrie, OK

Mike Honigsberg
Garfield County Emergency Management
Enid, OK

Ben Springfield
Lincoln County Emergency Management
Chandler, OK

## 1. INTRODUCTION

Crawford and Morris (2000) clearly demonstrated that a data-telecommunications problem has existed for many years between the National Weather Service (NWS) and local public-safety agencies. Based on this perception, the Oklahoma Climatological Survey (OCS) began the OK-FIRST program (and a potential national prototype program known as ONALERT; Kloesel *et al.* 2000a,b) to serve as an information- and support-bridge between the modernized NWS and local public-safety officials (fire, law enforcement, and emergency management). As a result, Oklahomans have made great strides in how they deal with weather emergencies. In addition, many local governments have developed a proactive approach to decisions that involve the weather (James *et al.* 2000; Morris *et al.* 2000). Applications of this new way of doing business have been varied and wide-ranging, from investigations of homicides and aircraft accidents to scheduling of public works projects and protecting audiences at outdoor concerts, parades, and sporting events.

The central Oklahoma tornado outbreak of 3 May 1999 exacted a horrific toll across the state (Figure 1). It has been estimated that over 10,000 buildings were either damaged or destroyed, but human casualties were limited to 44 fatalities and under 800 injuries. Other estimates have conjectured that hundreds of fatalities would have resulted from this same outbreak had it occurred only a few years ago. Most of the human casualties and property loss occurred across heavily-populated sections of central Oklahoma. The NWS and the broadcast media performed superbly during 3 May 1999 outbreak; actions of the media prevented much greater loss of life in the Oklahoma City metropolitan area, where they focused much of their coverage. Yet, several rural communities suffered much greater physical and economic loss per capita than did the metropolitan area. As a direct result of the storms, the town of Stroud lost its three major employers and over half of its tax base. The town of Dover suffered damage or destruction of two-thirds of its buildings; nearly every structure in Mulhall experienced major damage or destruction. Amazingly, only one fatality resulted in these rural communities. Law enforcement units were ready to provide warning in these towns and were deployed based on information obtained from OK-FIRST. In addition, rescue workers were in danger as this prolonged outbreak produced tornadoes over a widespread area. Emergency managers guided the response workers to safety as they were threatened by additional storms. This manuscript provides anecdotal evidence of the benefits that advanced and timely weather information provide to local communities during a disaster situation.

## 2. TESTIMONIALS FROM 3 MAY 1999

As a result of using the OK-FIRST system, many rural public-safety officials have become proactive rather than reactive when dealing with weather-impacted situations. Stellar examples of this new approach to their duties were revealed through life-saving actions which resulted from decisions made during the killer tornado outbreak of 3 May 1999 — significant stories that did not receive widespread media attention. For example,

- Steve Chapman, Emergency Management Director for the town of Chickasha (location "1" in Figure 1), used pinpointed information from his OK-FIRST displays (resulting from combined NWS and NEXRAD information; Figure 2) to discern the municipal airport was

* *Corresponding Author's Address*: Dale A. Morris, Oklahoma Climatological Survey, 100 E. Boyd, Suite 1210, Norman, OK 73019; e-mail: dmorris@ou.edu; http://okfirst.ocs.ou.edu

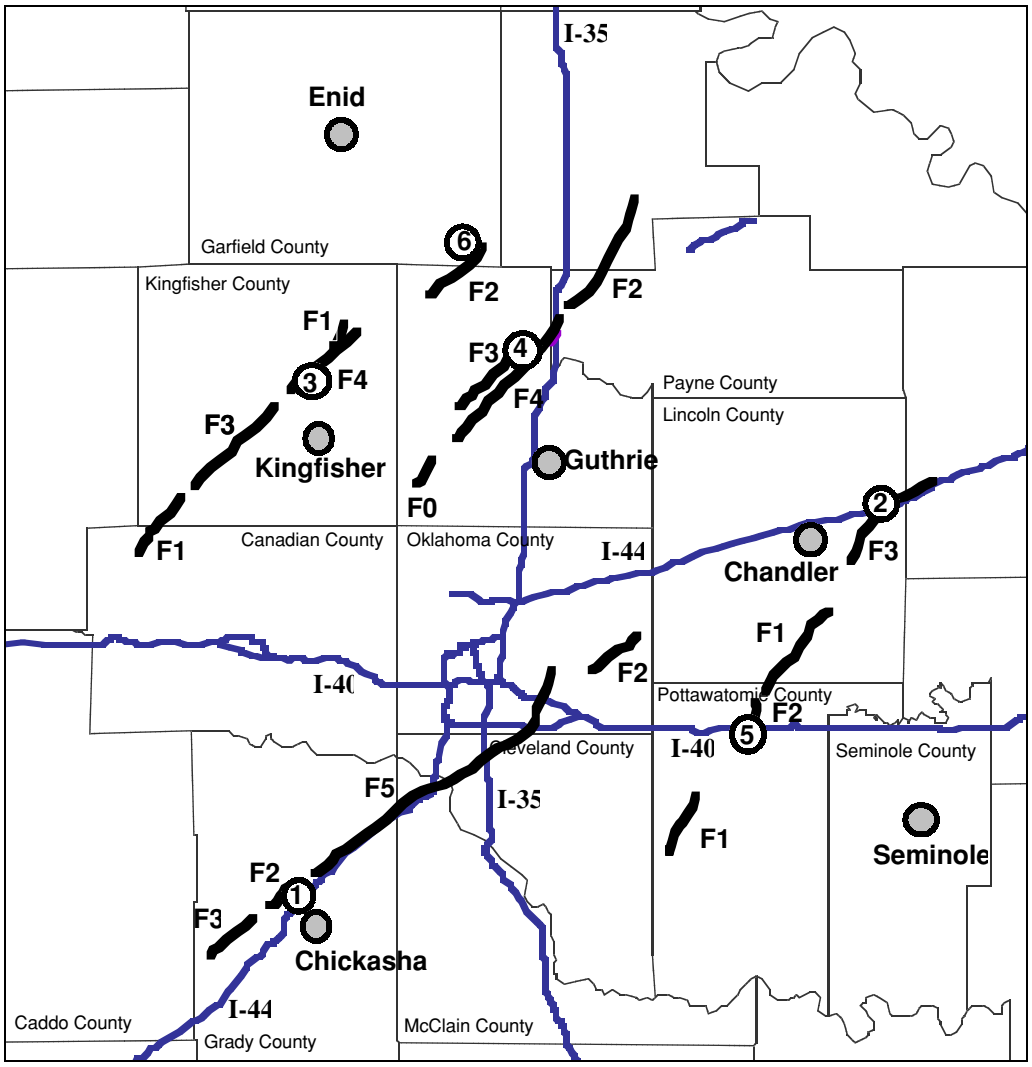


**Figure 1**. Approximate damage paths and Fujita damage scale ratings for many of the tornadoes in central Oklahoma on 3 May 1999. Gray circles locate emergency management offices discussed in the text. Numbered circles denote areas impacted by decisions based on OK-FIRST: 1. Chickasha Municipal Airport; 2. Town of Stroud and Tanger Outlet Mall; 3. Town of Dover; 4. Town of Mulhall; 5. I-40 exit near Shawnee. Adapted from NOAA (1999).

threatened by one of the first tornadoes of the day. Accordingly, he evacuated the Chickasha airport — a full fifteen minutes before the tornado struck. No fatalities or injuries resulted.

- Later that evening, when another tornado demolished an outlet shopping mall in Stroud (location "2" in Figure 1; Figure 3), all stores had been vacated. Ben Springfield, Lincoln County Emergency Management Director, was provided frequent radar updates from OK-FIRST, and notified Stroud 30 minutes in advance.

- People in their homes in rural areas also were more secure thanks to the actions of emergency managers that day. After the storms had spun their path of destruction across the Oklahoma City area, they continued northeast. Residents in rural areas received minimal attention from the media, as local news focused much of their coverage upon the devastation and recovery operations

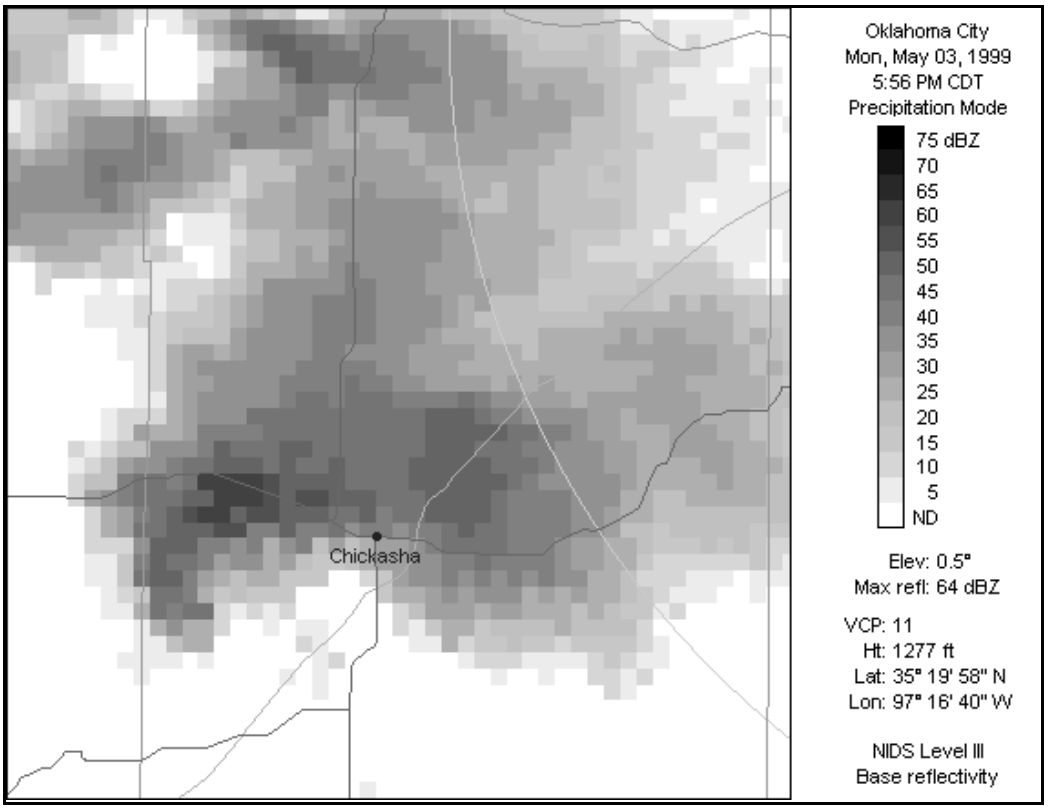


**Figure 2.** Gray-scale version of base reflectivity from the Oklahoma City WSR-88D, indicating a hook echo near the town of Chickasha. Steve Chapman used a color version of this image to decide to evacuate the airport, which is located a few miles northwest of Chickasha.

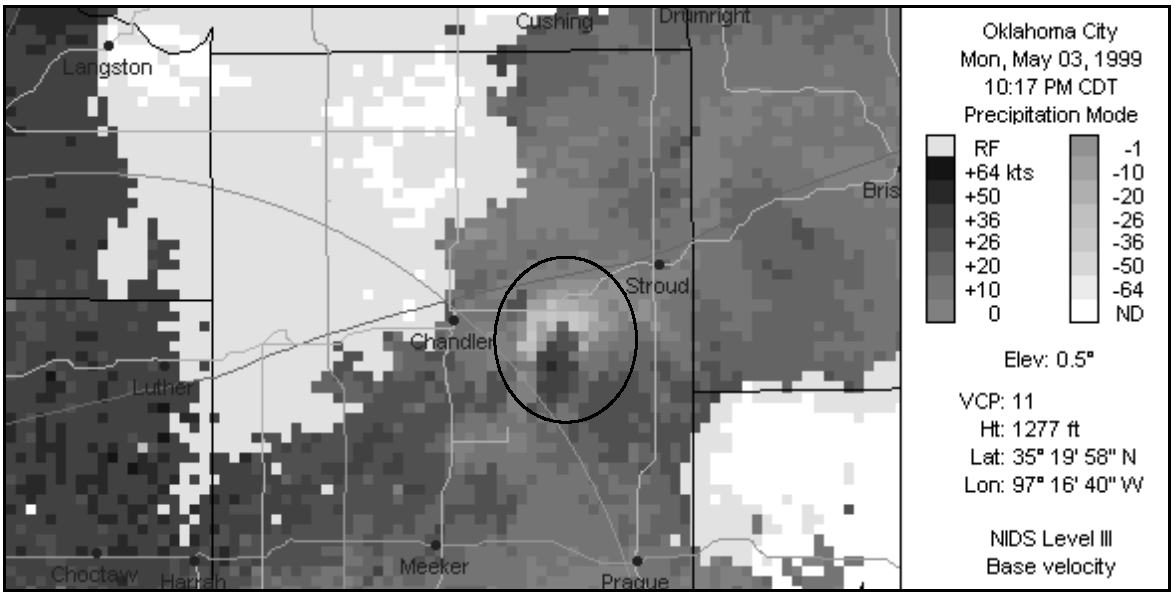


**Figure 3.** Gray-scale version of base radial velocity from the Oklahoma City WSR-88D. A couplet of inbound and outbound velocities is highlighted with a circle for clarity in this manuscript. This rotational signature was located between the towns of Chandler and Stroud, approaching the Tanger Outlet shopping mall.

in and near Oklahoma City. One of Springfield's assistants, who was monitoring the OK-FIRST radar displays, relayed updates every five minutes on radio frequencies received by scanner. Potential victims received the information and took shelter. Springfield later said that many of these people would otherwise not have taken shelter had it not been for the trustworthy information coming across their scanner.

- In Kingfisher County (Figure 4), the town of Dover (location "3" in Figure 1) was hit hard, with two-thirds of the houses either destroyed or damaged. Danny Mastalka, Director of Kingfisher County Emergency Management, caused emergency vehicles (including those belonging to police, sheriff, and game warden officials) to traverse the streets to warn the town's citizens 10 to 20 minutes in advance of the storm. The lone fatality in Dover was an individual who chose not to take immediate action after receiving the warning.

- Rescue workers themselves were targets of the storms. A tornado completely destroyed the small community of Mulhall in Logan County (location "4" in Figure 1). Rescue workers set up a command center to manage the recovery operations. John Lewis, Logan County Emergency Manager, saw successive tornadoes following similar paths on his OK-FIRST system (Figure 5). He alerted the command center to move their operations — twice. As a result, the rescue workers did not themselves become victims of the storms. In his letter of 10 May 1999, Lewis stated:

  "When police and rescue crews arrived at the first Logan County damage site near the City of Crescent, one of the first tasks was to open the highway sufficiently to get an ambulance through from Crescent to the hospital in Guthrie. All efforts were to get that ambulance moving with a critically injured tornado victim. About the time they succeeded, a second tornado approached in the dark. The ambulance and the tornado moved on intersecting paths. Emergency management, aware of both events, was able to stop the ambulance until the tornado passed just in front of it."

  "The town of Mulhall, devastated by the initial tornado after it passed Crescent, was warned primarily by two law enforcement units sounding their vehicle sirens in the town. The units had been dispatched there by the Sheriff's Office based upon OK-FIRST data. Both units continued warning residents until they were each hit by debris: one by power lines down across his car, the second by a large tree upon his unit. Both officers were uninjured — and so were all but one Mulhall town resident!"

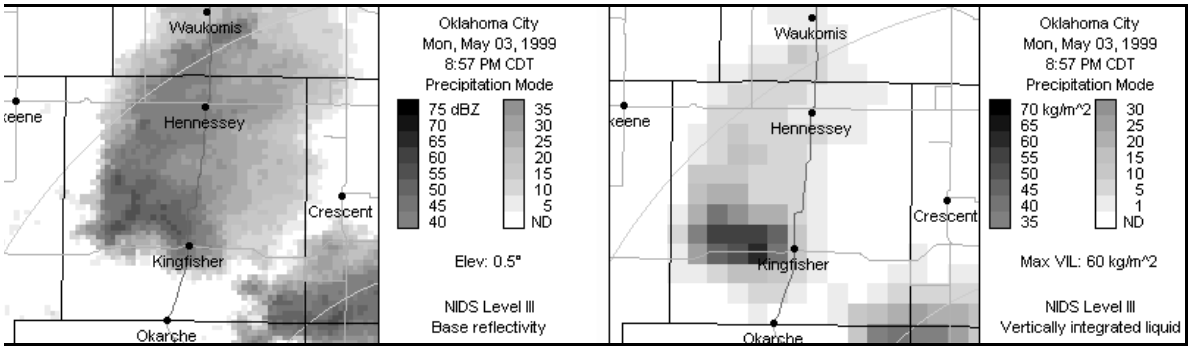


**Figure 4.** Gray-scale version of base reflectivity (left) and vertically integrated liquid (right) from the Oklahoma City WSR-88D at 2057 local time. Danny Mastalka used these images to note that a tornadic supercell thunderstorm was west of Kingfisher and headed for the town of Dover (between Kingfisher and Hennessey). The largest values of vertically integrated liquid were also located west of Kingfisher (co-located with the hook echo), indicating a strong updraft with suspended precipitation particles.

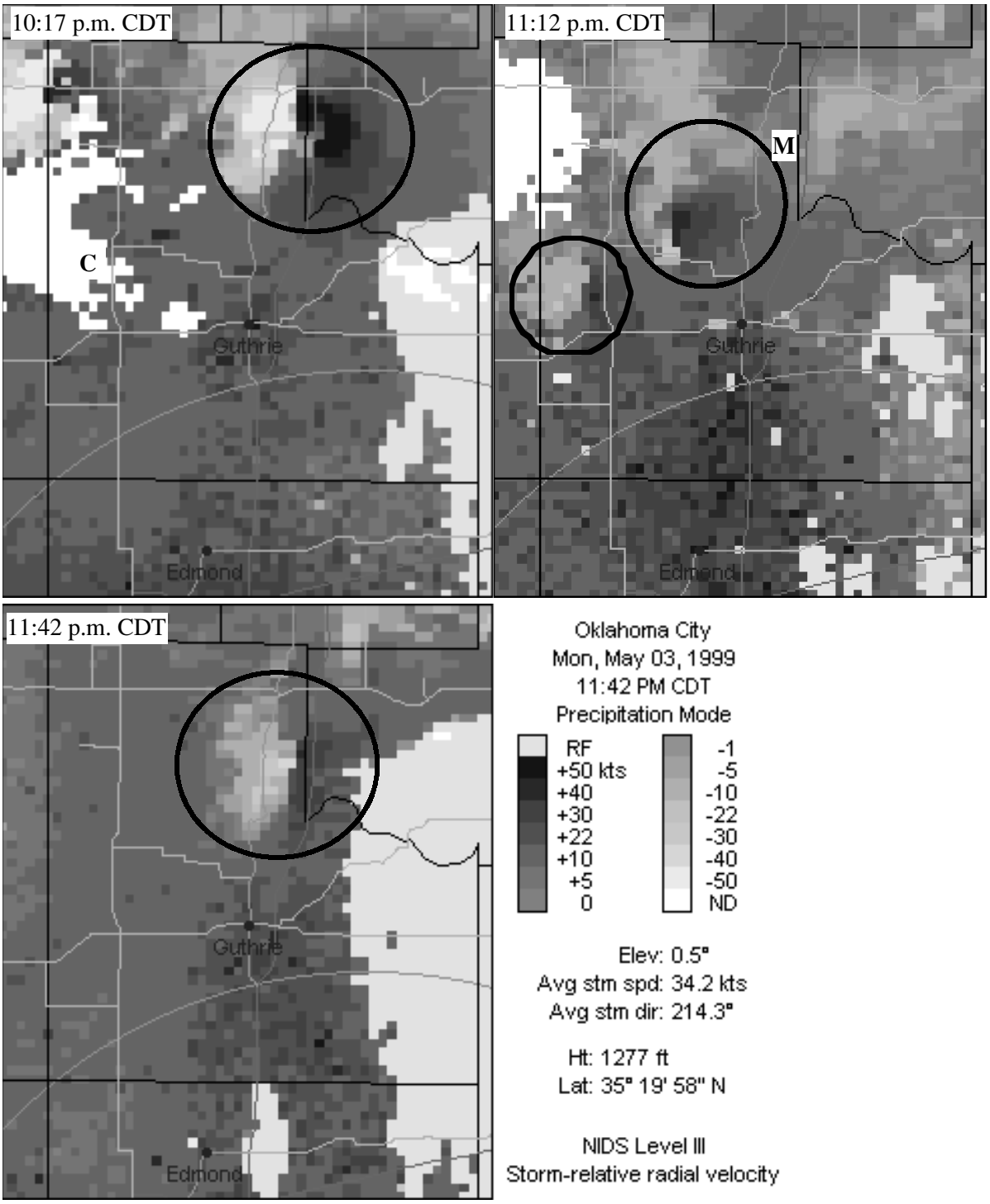


**Figure 5.** Gray-scale versions of storm-relative radial velocity from the Oklahoma City WSR-88D at 10:17 p.m., 11:12 p.m., and 11:42 p.m. local time. Circled areas were added for clarity in this manuscript to highlight tornadic supercell thunderstorms (*i.e.,* radial velocity couplets). Light thin lines denote various highways. The circled storm at 10:17 first hit the Crescent area (marked by "C") and subsequently the town of Mulhall (denoted by "M"). Crescent was sandwiched between two tornadoes at 11:12 that followed similar tracks. The southwestern storm at 11:12 (just entering Logan County) was the same storm that was near the Mulhall area at 11:42. Color versions of these images were guidance for the decisions made by Logan County Emergency Management as discussed in the text.

Practically every structure in Mulhall, a community of 945 citizens, was destroyed, including the town's only water tower which had stood since the 1920s.

- In Seminole County, Emergency Management Director Herb Gunter radioed a warning to a caravan of emergency vehicles responding to the Oklahoma City area. Gunter noticed that another tornado was developing (Figure 6) and would cross an interstate highway ahead of them. The law enforcement convoy closed the highway (location "5" in Figure 1) so that neither they nor other vehicles would drive into the storm.

- In Garfield County (location "6" in Figure 1), seven chase teams monitored four supercell storms, including one that damaged a farm. Perhaps more importantly, other rescue teams from Garfield County traveled to the Oklahoma City area to assist with the aftermath of the storm there. Mike Honigsberg, Director of Garfield County Emergency Management, provided periodic updates of OK-FIRST information to successfully and safely maneuver these rescue teams around the intervening Dover and Mulhall storms.

- The damage that resulted from the hazardous weather on 3 May 1999 was not limited to the counties surrounding Oklahoma City. In far northeast Oklahoma, as attention remained focused on the central Oklahoma tornadoes, heavy thunderstorms with flood-producing rains brought 5-6 inches to Ottawa and surrounding counties on the night of May 3rd (Figure 7). Terry Durborow, Emergency Management Director of the City of Miami, used OK-FIRST to "help protect the public in a timely manner."

Thus, it would seem that OK-FIRST played an important role in saving the lives of many Oklahomans on the night of 3 May 1999. In addition, because first-responders themselves were also in grave danger, the use of OK-FIRST prevented even greater tragedies from occurring.

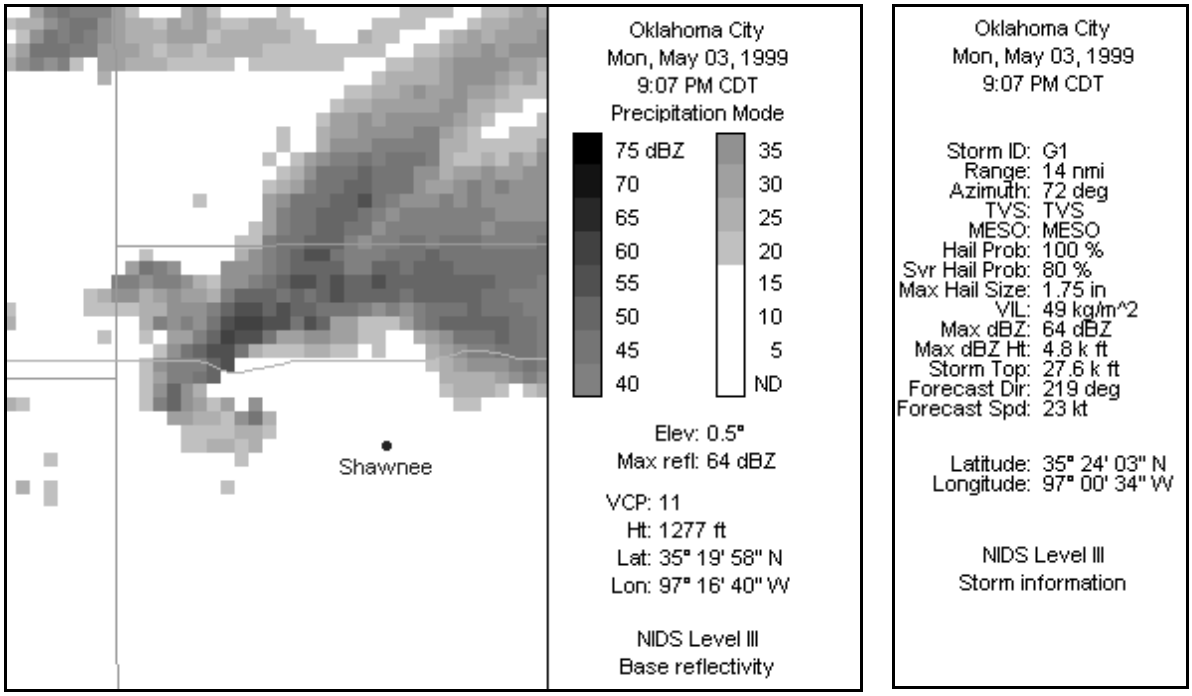


**Figure 6.** OK-FIRST images used by Seminole County Emergency Management to warn emergency vehicles. A hook echo in base reflectivity from the Oklahoma City WSR-88D at 9:07 p.m. local time (left) crosses interstate highway I-40, while a cursor read-out of storm attribute information (right) provides more detailed information.

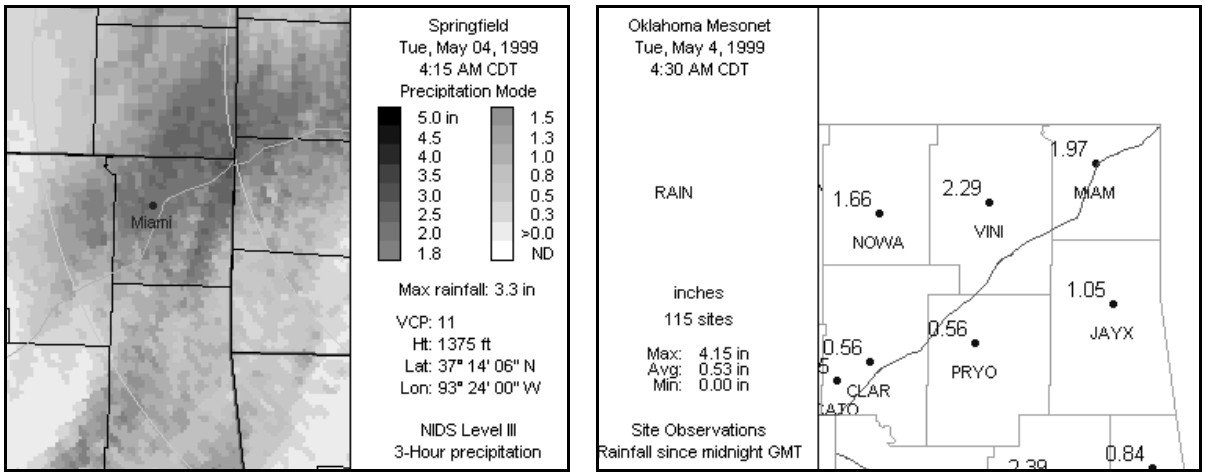


**Figure 7.** Three-hour rainfall accumulation from the Springfield WSR-88D radar at 4:15 a.m. local time, indicating more than 3 inches in Ottawa County near Miami (left) and total rainfall accumulations through 4:30 a.m. local time from the Oklahoma Mesonet (right). Corresponding flash food guidance values for Craig and Ottawa counties were 2.2 inches.

## 3. SUMMARY

As a result of operational successes on 3 May 1999 and during many other situations, OK-FIRST has become a catalyst for change in many local governments. Local officials are now empowered to close bridges during floods, save property in wildfires, improve evacuations after hazardous spills, and protect audiences at outdoor events. Other benefits include more efficient scheduling of public-works projects and information for police and fire investigations. An independent evaluator concluded (James *et al.* 2000) that OK-FIRST changed the behavior of its graduates and their approach to decision-making — for the better. Because OK-FIRST is widely used and has high recommendations from its users, the National Weather Service — following the May 3rd event — recommended national replication of a technology like OK-FIRST. Congress also authorized a national prototype to be built from OK-FIRST; it is known in Oklahoma as "ONALERT" (Kloesel et al. 2000a,b).

## 4. REFERENCES


Crawford, K.C., and D.A. Morris, 2000: Collaborations between meteorologists and emergency managers: the Oklahoma tornado of 3 May 1999, Part 1: the historical foundation. *Preprints, 2nd Symposium on Environmental Applications,* Amer. Meteor. Soc., Long Beach, CA (in press).

James, T.E., P.O. Long, and M.A. Shafer, 2000: An independent evaluation of the OK-FIRST decision-support system. *Preprints, 2nd Symp. on Environmental Applications*, Amer. Meteor. Soc., Long Beach, CA (in press).

Kloesel, K.A., K.C. Crawford, R.A. McPherson, D.A. Morris, R. Jesuroga, and C. Subramaniam, 2000a: Applying environmental data to aid decision-making during hazardous weather events. *Preprints, 2nd Symp. on Environmental Applications.* Amer. Meteor. Soc., Long Beach, CA (in press).

Kloesel, K.A., K.C. Crawford, R.A. McPherson, D.A. Morris, R. Jesuroga, and C. Subramaniam, 2000b: Leveraging the Internet to aid decision-making during hazardous weather events. *Preprints, 16th International Conf. on Interactive Information and Processing Systems for Meteoro,. Oceano., and Hydrology.* Amer. Meteor. Soc., Long Beach, CA (in press).

Morris, D.A., K.C. Crawford, H.L. Johnson, R.A. McPherson, M.A. Shafer, and J.M. Wolfinbarger, 2000: OK-FIRST: an innovative information-support system for public-safety agencies. *Preprints, 2nd Symp. on Environmental Applications.* Amer. Meteor. Soc., Long Beach, CA (in press).